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Regulatory Compensation Limits and Business Performance – Evidence from the National Football League

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ABSTRACT

Executives' compensation has been on the forefront of the public and political debate since the recent financial crisis. One of the measures publicly discussed is a general upper boundary to top management compensation packages ("salary cap", "maximum wage"). While such measures are novelties to the corporate world, the North American major sports leagues have been using maximum compensation regulations for decades. This paper exploits the 23-year experience with salary cap regulations from the National Football League (NFL). The results show a significant negative relation between the success of NFL teams and the amount of the net (after-tax) salary cap represented by the personal income tax rate of the teams' home states. A team from California (highest average tax rate) wins 2.256 games less per year and has an 11% reduced probability of making the playoffs than a team located in a no-tax state such as Florida or Texas. The paper contributes to and informs the ongoing public and political debate regarding the regulation of executive compensation, and its effects on the performance of the regulated entities.

Keywords: CEO, compensation, executive, maximum wage, tax

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1. Introduction

Scientific research has shown that many companies try to attract the seemingly most talented individuals for directors and higher management positions by offering compensation packages (fixed salary and performance based bonuses) that appear to be far beyond the compensation levels of regular workers (see Frydman, and Jenter (2010); Krenn (2016)). For instance, in the U.S. the CEO-to-worker compensation increased from a ratio of 20-to-1 in 1965 to a ratio of 510.7-to-1 in 2013 with an average CEO pay of USD 24.8 million (Mishel, and Davis 2014). Similarly, in 2014 the average CEO pay disclosed by UK FTSE 100 firms was 125 times the average employee pay pointing to a mismatch regarding compensation levels (Krenn 2016).

Recent developments of compensation practices of directors and top managers have not only stimulated academic research, but also opened an ongoing public debate about the level and composition of executive compensation. In a world of perceived growing inequality (Piketty 2014), this discussion has raised questions such as whether and how to regulate payments made by firms to their executives. It appears that in the last years many governments around the world have begun to show their response and started to directly or indirectly regulate management compensation.

One of the discussed methods of regulating and reducing executive compensation is a mandatory upper boundary to executive compensations ("maximum wage") (Brockway 1984; Ramsay 2005; Friedman 2008; Rowlingson, and Connor 2011; Blumkin, Sadka, and Shem-Tov 2013). The idea of using maximum wage rules however is not a new one. It reaches back to Aristotle (see Miller (2008)), who suggested that no one should have more than five times the wealth of the poorest person. During the second world-war, concerned by war profiteering, U.S. president Franklin D. Roosevelt proposed a maximum income of USD 25,000 in 1942, accompanied by a 100% tax on all income above this level (Blumkin et al. 2013). Somewhat surprisingly, the literature has by and large overlooked binding maximum wage rules and their effects on the market for managerial labor as well as the subsequent effects on the regulated firms' performance.

This paper exploits the experience with salary cap regulations from the National Football League (NFL) to draw implications for the introduction of a mandatory upper boundary of employee compensation on the affected firm's performance. The NFL introduced a team wide salary cap in 1993 (effective 1994) that limits the annual salaries paid in total to the players of a team to a predefined amount (in 2016: USD 155.27 million per team). To achieve a certain level of competitive balance between the teams, the NFL additionally regulates important aspects of the game such as the number of players a team can hire, the number and intensity of practice and training sessions, the general conditions of player-contract negotiations or the selection process of college players ("NFL draft").[1] As the salary cap is a gross (pre-tax) amount, the different state personal income tax rates effectively institute individual salary caps for every team depending on its home state. The NFL thus provides an exceptional framework for studying competitive disadvantages imposed by different numerical limits to the compensation of highly mobile, highly skilled and highly specialized workforce without having to control or adjust for other socio-economic between subject variations (e.g. size, industry, profitability, regulatory framework, culture, etc.).

Over the sample period, (1994-2016) the empirical analysis shows that teams located in high tax states are significantly less successful than low tax states' teams. On average teams in high tax states win 0.2 games per year less and have a 1% lower probability of making the playoffs per every percentage point of tax differential. For example, a team from California which has the highest average state personal income tax rate over the whole observation period wins 2.256 games (or 14.1% of the 16 game season) less per year and has an 11% reduced probability of making the playoffs than a team located in a state without personal income tax such as Florida or Texas. The results are robust to various alternative tests, models and sub-samples.

The results of this paper contribute in general to the accounting literature on executive compensation and specifically to its sub-stream focusing on compensation limits and mandatory compensation regulation. It is the first paper to empirically investigate the relation between regulatory imposed compensation limits and the affected legal entity's performance and success. The paper also

[1] See further the Collective Bargaining Agreement (August 4, 2011) between the NFL and the players union ("NFLPA"), available at https://www.google.at/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&sqi=2&ved=0ahUKEwi31_a_su_SAhVJQZoKHQh0D7cQFggaMAA&url=https%3A%2F%2Fnfllabor.files.wordpress.com%2F2010%2F01%2Fcollective-bargaining-agreement-2011-2020.pdf&usg=AFQjCNGKpuUA1kvqqsfwzOLq4HOhKGiJFA&sig2=aaMd22lAgpyI78Zp-nMHTQ&bvm=bv.150729734,d.bGs (March 24, 2017).

contributes to and informs the ongoing public and political debate regarding the level of executive compensation and the perceived need for regulatory action. The results show that even within a sector/region that is highly insulated against emigration of workforce towards other sectors/regions the implementation of a regulatory compensation limit could have long-term effects on the labor market, the availability of compatible talent and subsequently the performance of the affected entities.

The remainder of the paper is structured as follows: section 2 presents relevant related literature. The theoretical background, which motivates the empirical analysis and develops the hypothesis, is presented in section 3. Section 4 presents the framework for the empirical analysis, results and robustness checks are presented in section 5; section 6 concludes.

2. Literature Review

The issue of salaries and especially CEO / director compensation and limits to it have been dealt with by the scientific literature quite extensively. There is a large stream of literature focusing on the relation between CEO / director compensation and business performance. Usually this literature investigates the impact of business performance on the compensation of directors, its amount and its composition (fixed salary vs performance based components). The first empirical studies on the relation between business performance on the compensation of directors were published during the 1960s and 1970s (see McGuire, Chiu, and Elbing (1962); Lewellen, and Huntsman (1970); Cosh (1975)). One of the main objectives of executive pay arrangements is the alignment of shareholder and executive interests (Jensen, and Murphy 1990; Bebchuk, and Fried 2003) and the reduction of agency problems (see for an overview Murphy (1999); Devers et al. (2007); Edmans, and Gabaix (2016); Barkema, and Gomez-Mejia (1998)).

Already in the mid-1990s, a similar public debate as the current led to the introduction of a limited tax deductibility of certain parts of a CEO's remuneration in the United States. Section 162(m) of the Internal Revenue Code (effective 1994) limited the corporate income tax deductibility of compensation paid to the CEO and the next four highest-paid executives to USD 1 million each (so-called "Million-Dollar Cap"). The "Million-Dollar Cap" did not impose a general upper limit to executive remuneration but introduced an indirect measure aimed at compelling corporations to refrain from higher salaries as it increased the cost of high salaries. Additionally, section 162(m) only included fixed salaries and excluded variable (performance based) components. While the theological aim was to reduce excessive executive remuneration, the analytical and the empirical literature showed an opposite trend. Hall, and Liebman (2000); Rose, and Wolfram (2000); Rose, and Wolfram (2002); Halperin, Kwon, and Rhoades-Catanach (2001); Balsam, and Ryan (1996); Balsam, and Qin (2005); Balsam, and Ryan (2007, 2008) and Göx (2008) show empirically or analytically that section 162(m) did not significantly limit the absolute amount of executive remuneration. The "Million-Dollar Cap" however changed the composition of the remuneration packages towards a higher importance of performance-based components.

The recent financial crisis and the related bailout measures brought the public discussion on limiting executive compensation back. The general media and national governments not only discuss and implement indirect measures such as section 162(m) but also direct measures such as special personal income taxes on high salaries, maximum CEO-to-worker pay ratios and maximum wage laws for executives prohibiting remunerations that are perceived as too high. The research – especially empirical research – on such measures and their influence on CEO pay but also on the performance of the affected firm is very scarce. Krenn (2016) analyses theoretically the influence of (special) wage taxes on CEO remuneration on the hiring process of CEOs. He finds that when two companies compete for hiring the same individual to become their CEO the personal income tax rate of the CEO can alter the competition. Using an LEN model he shows that sufficiently large tax rate differentials can lead to a suboptimal allocation of CEO talent as the individual who is most compatible with one firm could end up being hired by the other firm.

Dittmann, Maug, and Zhang (2011) discuss several restrictions on executive pay and analyze three types of restrictions: restrictions on ex post realized pay in order to avoid large payouts to executives across a range of possible scenarios (esp. "golden parachutes", "golden handshakes"), restrictions on components of pay (fixed vs variable), and, finally, restrictions on the ex-ante value of pay ("maximum wage"). They show analytically, that after the implementation of a mandatory maximum compensation rate firms cannot provide the same level of incentives and cannot attract executives of the same quality (talent, capability, effort, etc.) as before. Firms are thus not able to hire the most compatible executives anymore leading to frictions in the market for managerial labor. Dittmann et al. (2011) also estimate the average reduction in firm value when firms are forced to reduce the total CEO pay due to the maximum wage law at 0.07% per 20% pay reduction.

Abudy, and Shust (2016) analyze the stock market's reaction to the introduction of a maximum wage law in Israel in 2016. The Israeli "Executive Compensation in Financial Corporations Act" is a unique law as it specifies a mandatory upper limit to executive compensation of financial corporations. An annual executive compensation of more than 2.5 million New Israeli Shekel (approximately USD 650,000) must not be granted if it is more than 35 times the lowest salary paid by the corporation. While the law became effective on Jan 1, 2017 Abudy et al. (2016) analyze the reaction of the Tel Aviv stock exchange to the final approval of the law in the Israeli parliament. In their event study, they find a statistically significant positive cumulative abnormal return on the trading day(s) following the law's enactment suggesting that the enactment of the law had a positive influence on the value of the affected firms. While the Israeli "Executive Compensation in Financial Corporations Act" is an exceptional and very intriguing legal measure, the long-term effects of the law, its ramifications on the market for managerial labor and on the firms' performances if less compatible individuals are hired, could not have been studied yet. Additionally, the limited scope of the law (banks, insurances, financial services, etc.) makes it difficult to generalize the findings of Abudy et al. (2016).

3. Theoretical Analysis and Hypothesis

As shown, the literature – esp. the empirical literature – has not studied the long-term effects of the introduction of a mandatory compensation limit on the managerial labor market and on its ramifications on firm performance. The main reason for the scarce empirical results can be seen in the rarity of such legal measures being actually adopted. Transposing the results of the theoretical literature to the introduction of a mandatory maximum compensation one is inclined to expect it to be negatively related to the probability of hiring the most compatible individual as executive (Krenn 2016) and subsequently the firm's performance (Dittmann et al. 2011).

Building on the model of Dittmann et al. (2011), the analysis of the relation between maximum pay regulations and firm performance, uses a standard Cobb-Douglas production function assuming that the firm's performance F is influenced by the effort e and the level of talent t (i.e. the level of compatibility of the individual's skills to the firm's specific needs) of its employees; κ summarizes all other factors influencing F (β and γ are elasticities):

$$F = \kappa * e^{\beta} * t^{\gamma} \quad (1)$$

The employees are effort-averse, so that the owner of the firm compensates the employees for the cost of effort $EC(e)$ and for their talent level $TC(t)$. Both, the cost of effort and the cost of talent are assumed to have isoelastic supply functions (Dittmann et al. 2011) that relate the costs (=compensation) to the level of effort and talent respectively (φ and δ are elasticities):

$$EC(e) = e^{\varphi} \quad (2)$$

$$TC(t) = t^{\delta} \quad (3)$$

The compensation (Π) of any employee thus depends on the effort provided to the firm and on the individual talent level:

$$\Pi = EC(e) + TC(t) \quad (4)$$

Under the legal constraint of a maximum wage ($\overline{\Pi}$ with $\Pi \leq \overline{\Pi}$) the compensation (for all $\Pi > \overline{\Pi}$) changes to:

$$\overline{\Pi} = EC(e) + TC(t) \quad (5)$$

Under the assumption of effort-averse employees a reduced compensation ($\overline{\Pi}$) would lead to a reduced level of effort ($\overline{e(\overline{\Pi})}$ with $\overline{e(\overline{\Pi})} < e$). Alternatively, assuming sufficiently mobile employees that could either physically relocate out of the geographical scope of the maximum wage or change the industry if the maximum wage is not applicable to the whole economy, the maximum wage could lead to a reduction in available compatible talent ($\overline{t(\overline{\Pi})}$ with $\overline{t(\overline{\Pi})} < t$). In both instances, the introduction of a maximum wage could have negative effects on the firm's performance ($\bar{F}$ with $\bar{F} < F$) due to the relation between firm performance (F) and effort ($\overline{e(\overline{\Pi})}$) and talent ($\overline{t(\overline{\Pi})}$):

$$\bar{F} = \kappa * \overline{e(\overline{\Pi})}^{\beta} * \overline{t(\overline{\Pi})}^{\gamma} \tag{6}$$

Based on this brief theoretical analysis of the influence of a mandatory maximum wage on the affected firm's performance the hypothesis for the following empirical analysis reads as follows:

Hyp: A mandatory maximum wage leads to a reduced performance of the affected firms.

4. Empirical Analysis

4.1. Investigation Strategy

The empirical analysis exploits data from the NFL. The NFL as one of the four major North American sports leagues introduced a salary cap for every 32 teams in 1994. The salary cap[2] establishes a maximum total amount that every team can spend on its 53 players per year. Because of the tax rate differences in state personal income taxes the NFL serves as an ideal framework to investigate the influence of a maximum wage in a setting where workforce is highly mobile, highly skilled and highly specialized. As all teams are subject to the salary cap, they all have to comply with the same rules with respect to player contract negotiations and contractual terms. All teams are similar in size and activity; the number of players each team can add to its active roster (53 players) is regulated as is the number of games each team plays and even the number of training and practice sessions is regulated by the collective bargaining agreement between the NFL and the players' union ("NFLPA"). Therefore, it is a setting where the variation between the subjects is very small compared to regular cross-sectional or international empirical studies that require extensive adjusting and controlling for differences in size, profitability, activity, ownership, culture, etc.

2 The salary cap of the NFL is regularly referred to as "hard cap" (Krautmann, and Solow 2012; Leeds, and Kowalewski 2001; Borghesi 2008; Nissim 2004). A hard cap is an absolute maximum amount that a team can spend over the course of each season with no exceptions while a "soft cap" would allow for crediting an overspending against the following year's salary cap (Nissim 2004). The NFL has to approve all contracts between a team and a player to become effective; therefore, the salary cap cannot be exceeded.

The main variation between the subjects originates from the applicable personal income tax rate of the home state of the team. All states with a personal income tax reserve the right to tax any resident and non-resident on professional income earned in the state. This policy applies to any non-resident, but it is typically applied mainly to high-profile and high-income professional athletes (so called "jock tax") like NFL players (Alm, Kaempfer, and Batte Sennoga 2012). The commonly used allocation method is based on "duty days". Duty days represent the number of days that the player spends in providing professional services in a state. The total salary of the player is then allocated across states in which he plays in accordance to the proportion of the total duty days spent in each state (DiMascio 2006; Ekmekjian 1994; Ekmekjian, Wilkerson, and Bing 2011; Farnsworth 2013; Nolan 2016). Usually, the total number of a NFL player's annual duty days (pre-season and regular season practices, home games and away games, playoffs) is assumed to be around 200 (Pogroszewski 2008; Zelinsky 2015). Away games usually count as two duty days as teams travel to the location of the away game one day in advance and leave right after the game. In total, this amounts to 16 duty days out of the home state (8%-10% of total duty days) per season. The personal income tax rate of the home state is therefore the most important factor determining the tax burden of any NFL player as 90% of the player's salary is taxable in that state.

Taking the differences in the state personal income tax rates into account, every team has an individual after-tax salary cap. The annual salary cap figure is adjusted at the beginning of the league year and depends on the overall revenue of the whole league. The first salary cap in 1994 was set at USD 34.608 million and increased steadily by around 8.1% per year with the salary cap of the 2016 season being USD 155.27 million. Thus, in 2016 every NFL team is allowed to pay every of its 53 players on average an annual (pre-tax) salary of USD 2,929,622.64.

The aim of the salary cap is to ensure competitive balance between all 32 teams. Competitive balance within a sports league is important for the overall attractiveness of the league and its games to fans and the media. The uncertainty of the outcome of a particular game is critical to spectator interest, which relates to media attention and commercial success of the whole league (Rosen, and Sanderson 2001).

It is thus in the overarching interest of the owners of the sports teams to ensure a certain level of competitive balance among all participating teams (Rosen et al. 2001; Mondello, and Maxcy 2009).[3]

The 32 NFL teams are located in 22 different states with (in 2016) 19 different tax rates. Seven teams are located in states with no personal income tax (Florida, Tennessee, Texas, and Washington); four teams are located in California with the highest personal income tax rate of 14.10%. The average state personal income tax rate of all 32 teams in 2016 is 5.44% (median: 5.00%).

[Insert Table 1 about here]

Table 1 provides an overview of personal state income tax rates of all 32 NFL teams in 2016. The table splits the teams between playoff teams and non-playoff teams. The difference in the average tax rates of playoff teams (4.62%) and non-playoff teams (5.93%), which amounts to 1.31 percentage points or 28.28% of the playoff teams' average tax rate, provides some intuition that the tax rate differences leads to competitive advantages and disadvantages.

After state personal income taxes (without accounting for federal income taxes and other charges), every playoff team can spend on average USD 2,794,274.08 for every of the 53 players and the non-playoff teams can spend on average USD 2,755,896.02, which is a difference of USD 38,378.06 per player per season. When focusing on the highest (California – 14.10%) and the lowest (Florida, Tennessee, Texas and Washington – 0.00%) personal income tax rates, the difference in average per player (after tax) spending amounts to USD 413,076.79 per season.

The different after-tax salary caps are similar to maximum wage regulations that set the threshold at different levels. A team located in a low tax state (e.g. Florida) has the possibility to pay higher (after tax) maximum wages than a team located in a high tax state (e.g. California) ($\overline{\Pi}_{LowTax} > \overline{\Pi}_{HighTax}$). For a player who is geographically mobile and able to choose where to play (undrafted and/or unrestricted free agents) that difference might be an incentive to play for teams in lower tax rate states. Teams with a lower after tax salary cap (high tax state) would be able to hire either less talented

[3] There is wide agreement in the literature that salary caps can indeed mitigate competitive imbalances in sports leagues because they prevent wealthy clubs with high market potential from bidding the full marginal value for additional talent (Fort, and Quirk 1995; Fort 2012; Rosen et al. 2001; Dietl, Duschl, and Lang 2011; Lee 2010). This effect allows less wealthy clubs to retain star players.

players ($\overline{t(\overline{\Pi})}_{HighTax} < \overline{t(\overline{\Pi})}_{LowTax}$) or players providing less effort ($\overline{e(\overline{\Pi})}_{HighTax} < \overline{e(\overline{\Pi})}_{LowTax}$). In both instances, the team with the lower salary cap (high tax state) could end up with a less competitive team, a lower level of team performance

($\overline{F_{HighTax}} = \kappa * \overline{e(\overline{\Pi})^{\beta}}_{HighTax} * \overline{t(\overline{\Pi})^{\gamma}}_{HighTax} < \overline{F_{LowTax}} = \kappa * \overline{e(\overline{\Pi})^{\beta}}_{LowTax} * \overline{t(\overline{\Pi})^{\gamma}}_{LowTax}$)

and therefore have fewer success in terms of wins and playoff appearances.

4.2. Model and Variables

To test that hypothesis, I collect performance data (wins, playoff appearances) of all NFL teams over the time-span 1994-2016. The estimation strategy is twofold: First, I estimate a within-group model that exploits the panel nature of the data and controls for team fixed and time effects. The dependent variable in this estimation is the number of wins (*Wins*). The explanatory variable of main interest is the state personal income tax rate (*StateTax*) of the team's respective home state during the regular season.

$$Wins_{i,t} = \alpha StateTax_{i,t} + \beta X_{i,t} + \mu_i + \eta_t + \varepsilon_{it} \qquad (7)$$

$X_{i,t}$ is a vector of control variables, μ_i are team-fixed and η_t are time fixed effects. The fixed-effects model seems appropriate for the analysis for two reasons. First, much of the variation in wins is between the teams rather than within the same team over time. Although it would be difficult to specify all the characteristics that determine the differences across teams, one can capture permanent differences between teams with team fixed effects. Similarly, there are many factors that may affect team wins over time, and I capture those differences with annual time effects. Second, the fixed-effects model is a within-group estimator that uses a weighted average of the within-team and the across-team variation to form the parameter estimates. Therefore, the estimate of the effects of state income tax variations measures how team wins change within panels of teams due to the presence or absence of a state income tax.

Second, I estimate a probit regression model with the dependent variable being *Playoff* indicating whether a team made the playoffs (*Playoff*=1) or not (*Playoff*=0):

$$Playoff_{i,t} = \alpha StateTax_{i,t} + \beta X_{i,t} + \mu_i + \eta_t + \varepsilon_{it} \quad (8)$$

Additionally, both models in equations (7) and (8) are estimated with an alternative tax rate measure: *TaxDiff*. *TaxDiff* measures the difference between the individually applicable tax rate and the average tax rate of all teams in the respective season. It thus represents the competitive advantage (disadvantage) of teams located in low tax (high tax) states.

$$Wins_{i,t} = \alpha TaxDiff_{i,t} + \beta X_{i,t} + \mu_i + \eta_t + \varepsilon_{it} \quad (7a)$$

$$Playoff_{i,t} = \alpha TaxDiff_{i,t} + \beta X_{i,t} + \mu_i + \eta_t + \varepsilon_{it} \quad (8a)$$

With respect to the control variables ($X_{i,t}$) I follow previous literature by including a number of variables that influence the success/performance of a football team. Previous literature and the general media have repeatedly focused on the importance of two distinct positions/functions in a football team and their influence on team success: the *quarterback* and the *head coach*.

The quarterback is the premier position on the team. Usually, he is responsible for delivering the ball to the appropriate teammate in hopes of advancing it. The majority of previous research on this topic focuses on the quality of defense and the quality of the individual opposing quarterback. The phrase "offense wins games, defense wins championships" is coined by coaches, players, and analysts. The study by Robst et al. (2011) finds no evidence that improving the defense leads to more team success. However, according to a study by Moskowitz, and Wertheim (2012) who investigated 427 playoff games between 1967 and 2012, the strength of the offense is more important. Out of these games, the higher ranked offensive team has won 62% while the higher ranked defensive team won 58% of the time.[4]

[4] The total exceeds 100% because sometimes the winning team is ranked higher in both offense and defense in comparison to its given opponent.

With respect to the quarterback, previous research has shown that the two factors *stability* and *experience* are highly important and are positively related to team success. Wittke (2012) shows a significant negative relation between the number of starting quarterbacks (quarterbacks that start the game) per season and winning percentage of all NFL teams over a ten-year period (2002-2011). Employing more than one starting quarterbacks means that either the player designated as starting quarterback after training camp and pre-season games got injured or performed poorly during the season. In both instances, the team's chances of winning games reduces dramatically. This finding by previous research is included as the control variable *QBstart,* which is the number of individuals starting a game at the quarterback position during the season. Regarding *experience* Wittke (2012), Leeds et al. (2001) and Simmons, and Berri (2009) show that teams that employ a quarterback with more years of experience have a significantly higher chance of winning more games. The control variable *QBexp,* which is the number of years of experience of the quarterback who starts the majority of the games during the season, incorporates this finding in the study.

While the position of the quarterback is of outmost importance for the success of any football team, using the quarterback as a control variable introduces some endogeneity to the model. As one of the 53 players on the active roster of an NFL, team the quarterback's salary counts against the team's salary cap. However, prior research and public media suggests that quarterbacks are relatively unaffected by the compensation restriction put in place by the salary cap (Leeds et al. 2001; Borghesi 2008). Starting quarterbacks regularly are the highest paid players on any team and account for around 10%-15% of a team's salary cap[5]. Additionally, top quarterbacks only very rarely become free agents, change teams and negotiate salaries with different teams.[6] Using the importance of the quarterback position for the success of the team as control variables therefore outweighs the risk of endogeneity; however, as a robustness check the models are estimated without using the quarterback variables (see section 4.4.2 below)

[5] See www.spotrac.com (March 27, 2017).

[6] See as one of these very rare occasion Peyton Manning, one of the statistically best quarterbacks in NFL history became a free agent in 2012. He left his previous team (Indianapolis Colts where he played for 14 seasons) to play for the Denver Broncos. His salary in the last season with Indianapolis: USD 16,000,000 (13.33% of the salary cap); his salary in his first season with Denver: USD 18,000,000 (14.93% of the salary cap).

With respect to the *head coach* prior research also shows that stability and experience are significantly important for team success. The findings of Hadley et al. (2000) and Wittke (2012) suggest basically the same pattern as with quarterbacks. More experienced head coaches have significantly more success measured as wins per season. Hadley et al. (2000) find that more experienced coaches are more efficient, implying that coaching experience contributes positively to a team's number of wins during the regular season. They conclude that a more experienced head coach can contribute up to four additional wins to his team in a given season. The control variable *CoachExp,* which is the number of years of experience the head coach had at the beginning of the season, incorporates this finding into the model. Similar to the quarterback, change at the position of head coach is significantly related to fewer team wins in the year of the coaching change. The variable *CoachChange* (an indicator variable that takes on the value 1 if the team changed the head coach during the year - before and during the season) accounts for that.

The control variables further consist of team specific variables that influence the overall success of the team. *Division* is an indicator variable indicating the division of the team. The NFL is divided into two conferences and each conference is divided into four divisions. The division/conference of the team decides the opponents the team faces during the season. Every team plays six games against the other three teams of the division, six games against other teams of the same conference and four games against teams from the other conference. Therefore the competitive strength of the own division (37.5% of games) and the strength of the own conference (75% of games) strongly influences the chances of winning games.[7]

With *LagWins* (number of wins in the previous season) and *5yearWins* (number of wins in previous five seasons) as well as *LagPlayoff* (indicator variable that takes on the value 1 if the team had made the playoffs in the previous season and 0 otherwise) and *5yearPlayoff* (number of playoff appearances

7 Note that the NFL realigned the divisions after the 2001 season to its current alignment (2x4 divisions with 4 teams each). Prior to that the NFL was aligned in two conferences with three divisions and each division had 5 teams (except for AFC Central having 6 teams). While the realignment changed the playing schedule to its current format, the previous scheduling format also put the emphasis on inter-division and inter-conference games.

in previous five seasons) the previous success of the team is incorporated into the model (see Pitts (2016)). See Table 2 for an overview of the variables used in the models.

[Insert Table 2 about here]

4.3. Data

As briefly addressed above, the empirical analysis is based on performance data (wins, playoff appearances) of all NFL teams over the time-span 1994-2016 (23 NFL seasons with 721 team-year observations). As every team plays 16 regular season games the 721 team-year observations are based on 11,536 regular season games. The data forms an unbalanced panel as four teams (so called expansion teams) in the sample did not play in all 23 NFL seasons of the sample period (the teams Carolina Panthers, Jacksonville Jaguars started to play in 1995; Cleveland Browns relocated after the 1995 season to Baltimore to become the Baltimore Ravens and was re-established as a new team in 1999; Houston Texans started to play in 2002). Table 3 provides a first overview of the teams, their success and the average state personal income tax rate of their respective home state.

[Insert Table 3 about here]

Average Tax Rate is the average statutory personal income tax rate of the respective home state over the whole observation period. Since several teams have relocated or have started playing at some point during the sample period,[8] the average tax rate differs several times within the same state.[9] The data is very homogeneous and the degree of skewness is very small. The average of the average tax rates is 4.97% (median: 5.44%) with the minimum at 0.00% and the maximum at 11.28%.

The average wins per season per team is 7.97 (median: 7.86) with the minimum at 4.89 and the maximum at 11.09. The total winning percentage has an average of 0.498 (median: 0.491)[10] with the

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8 Carolina Panthers, Cleveland Browns, Houston Texans, Jacksonville Jaguars were expansion teams; Baltimore Ravens, Tennessee Titans and Los Angeles Rams relocated.

9 See California, Maryland, Ohio.

10 The average (median) winning percentage is not 0.5 because of the unbalanced nature of the panel due to the expansion teams (Carolina Panthers, Cleveland Browns, Houston Texans, Jacksonville Jaguars); when excluding these teams the average and the median is 0.5.

minimum at 0.306 and the maximum at 0.693. On average teams have 8.63 playoff appearances (median: 7.50) and 0.72 Super Bowl titles. The most successful team over the whole observation period is New England Patriots (winning percentage of 0.693, 18 playoff appearances and 5 Super Bowl titles). The least successful team on the other hand is Cleveland Browns (winning percentage of 0.306, one playoff appearance and no Super Bowl titles).

Table 4 provides descriptive statistics on an observation-by-observation basis (721 team-years). The variable *Wins* is equally distributed. The average wins per team is 8 (median: 8) with the maximum of 16[11] and the minimum of 0[12]. The variable *Playoff* is moderately skewed which is due to the limited number of playoff spots per year (12 out of 32 teams can make the playoffs every year). *StateTax* (the statutory personal income tax rate of the team's home state) has an average (median) of 5.014 (5.150) with the minimum (maximum) at 0.00%[13] (14.10%[14]). *TaxDiff* representing the difference between the applicable state personal income tax and the average of all teams' state personal income tax rates in a respective season has an average of 0.00 (median: 0.146). The minimum is -5.337 and the maximum is 8.913.

On average teams have 1.688 (median: 2) quarterbacks starting a game (*QBstart*) per season with the maximum being 4 (in 14 team-year observations). The main starting quarterbacks have an average experience (*QBexp*) of 5.535 (median: 5) years, the maximum is 20 and in 51 team-year observations rookies were the main starting quarterbacks (*QBexp* = 0). The experience of the head coach (*CoachExp*) is similarly distributed (average: 5.463, median: 5.225, maximum: 32 years, minimum: 0 years) and teams change their head coach (*CoachChange*) 0.227 times per year (164 total coaching changes over the 23 year observation period).

[Insert Table 4 about here]

11 New England Patriots in 2007.

12 Detroit Lions in 2008.

13 Florida, Tennessee, Texas, Washington (throughout the whole observation period).

14 California (2012-2016).

5. Results

5.1 Main Analysis

Table 5 reports the results of the primary analysis. It is a fixed-effects panel regression over the whole period 1994-2016 with *Wins* as the dependent variable. The table includes six different specifications. Specifications (1)-(3) use *StateTax* and specifications (4)-(6) use *TaxDiff* as main variable of interest. Specifications (2) and (5) include the number of wins of the previous season (*LagWins*) to control for the general competitiveness of the team while specifications (3) and (6) use the average number of wins over the last five seasons (*5yearWins*) as an indicator of the long-term success of the team.

[Insert Table 5 about here]

Specifications (1)-(3) report statistically significant relations between a team's home state's personal income tax rate and the team's number of wins. In all three specifications, *StateTax* has a significant negative coefficient between -0.2042 and -0.2533. The results therefore show that a team located in a state with a one-percentage point higher tax rate than a second team wins on average 0.2 games less per season. For example, teams located in California (highest tax rate) over the whole observation period win 2.256 games per year (or 14.1% of the 16 games season) less than teams located in Florida, Tennessee, Texas, or Washington (no personal income tax). Specifications (1)-(3) also provide evidence that the number of wins during the last season (*LagWins*) is a significant indicator of future success, however only over the short-run as *5yearWins* is not significant.

Specifications (4)-(6) confirm these findings while using an alternative tax measure. *TaxDiff* measures the difference between the individually applicable tax rate and the average tax rate of all teams in the respective season. It thus represents the competitive advantage (disadvantage) of teams located in low tax (high tax) states. The results are very similar to the results of specifications (1)-(3). *TaxDiff* has throughout all specifications a statistically significant negative coefficient. Teams located in relatively high tax states (states with tax rates above the annual average) win on average 0.2 fewer games per season per percentage point difference to the average than teams located in low tax states. *TaxDiff*'s maximum (minimum) thus relates to 1.85 fewer (1.11 more) wins per season than the average tax rate.

Again, the previous season's number of wins (*LagWins*) is a significant indicator of future success, while the coefficient of *5yearWins* is not significant.

Additionally to the estimations reported in Table 5, which use the number of regular season *Wins* as a performance measure of the teams, Table 6 shows the results of a series of estimations that focus on the chances of making the playoffs. The dependent variable *(Playoff)* is a binary variable taking on the value 1 if a team qualifies for the playoffs in the respective year (and 0 otherwise). Qualifying for the playoffs is closely related to the number of wins, however because of the playoff seeding process of the NFL the twelve teams with the best regular season record are not guaranteed a playoff spot. The winners of the eight divisions and the other two best teams of either conference make the playoffs. Playoff seeding is thus also depending on the overall strength of the division. A team without having one of the six best win-loss-records in a conference can still make the playoffs if it wins its division.[15] Usually ten or more wins[16] in a season secure a playoff spot (see also Hadley et al. (2000)).

[Insert Table 6 about here]

Specifications (1)-(3) use *StateTax* as tax measure while specifications (4)-(6) employ *TaxDiff*. The results are similar to Table 5 however the statistical significance of the results is different. These differences are attributable to the specific playoff seeding procedure of the NFL, which is not exclusively dependent on a team's number of wins. All specifications find a negative relation between the applied tax measure (*StateTax; TaxDiff*) and the chances of making the playoffs. An increase in *StateTax* by 1 percentage point (marginal effects) relates to a 0.01 reduction in the chances of making the playoffs. A team located in California over the whole observation period has therefore an 11% reduced chance of making the playoffs than teams located in Florida, Tennessee, Texas, or Washington.

The main analysis reported in Tables 5 and 6 show a statistically significant negative relation between the personal income tax rate of a team's home state and that team's level of success. This relation is

15 See for example NFC Playoffs in 2010: Seattle Seahawks win the division with a 7:9 win-loss-record (qualifying for the playoffs) which was the eight best record and New York Giants with a 10:6 win-loss-record did not make the playoffs (second in the division and out of the top two non-division-winners).

16 Only eleven teams in the sample did not make the playoffs when winning 10 games, yet 60 teams made the playoffs with less than ten wins.

consistent throughout almost all specifications irrespective of the employed tax variable and irrespective of the success measure used. The results support the hypothesis developed above that teams, which are located in high tax states and have thus a smaller net salary cap and are thus financially more limited, perform on average at a lower level than teams located in low tax states.

5.2 Robustness Checks

The analysis reported in Table 5 estimates a fixed-effects model. While, as addressed above, the fixed-effects model seems appropriate for the analysis, I also estimate the same specifications with a random effects model – see Table 7.

[Insert Table 7 about here]

The results are largely unaffected: the coefficients of the tax variables have the same sign and similar significance levels. However, the Hausman (1978) specification test (not tabulated) indicates that the fixed-effects model is a better fit than the random effects model.

Table 8 and Table 9 report results of additional robustness checks that use various sub-samples of the main sample. Table 8 employs *StateTax* as tax measure and Table 9 uses *TaxDiff*. Specifications (1)-(3) of both tables focus on the unbalanced nature of the main sample. The main sample includes all teams that are active in 2016; however, four of these teams did not play during the whole sample period. Newly established teams (so-called "expansion teams") are regularly not as competitive as existing teams. The expansion teams record on average 6.71 wins per season (compared to 7.97 average wins per season for the whole sample). To check whether the results of the primary analysis are distorted by the expansion teams, observations of these teams are removed from the sample in specifications (1)-(3) of Table 8 and Table 9 but the results remain unchanged.

Specifications (4)-(12) of Table 8 and Table 9 remove the historically best team (New England Patriots – specifications (4)-(6)), the historically worst team (Cleveland Browns – specifications (7)-(9)) and both, the best and the worst teams (specifications (10)-(12)). The models remain the same as in the analysis reported in Table 5. Again, the results remain largely unchanged. The statutory personal income tax rate of the home state of the team has a statistically significant negative relation to the respective teams performance measured in wins (Table 8).

[Insert Table 8 about here]

And, the difference between the home state's personal income tax rate and the average personal income tax rate of all teams during the respective season (*TaxDiff*) (Table 9) is negatively related to a given team's performance (wins per season) and the relation is throughout almost all specifications statistically significant.

[Insert Table 9 about here]

The relations reported in the primary analysis might be skewed by observations of teams that are located in states that do not apply a personal income tax at all. Four states in the sample do not apply such a tax (Florida, Tennessee, Texas, and Washington) and seven NFL teams[17] are located in these states. These teams have a strong competitive advantage compared to the average tax rate (6.36 %) of teams located in states that levy a personal income tax. The estimations reported in Table 10 remove observations of these seven teams. The results (sign and significance level) are very similar to the results reported in Table 5. The effect size however is bigger throughout all specifications, which can be explained by the fact that two of the four expansion teams[18], which are not as competitive and successful as the pre-existing teams, are located in the no-tax states. Thus 28.6% of no-tax states teams are expansion teams, while 8% of the other teams are expansion teams. The average wins of no-tax state teams is therefore downward skewed (average wins of no-tax state teams including expansion teams is 7.80 and without expansion teams: 8.10) which explains the bigger effect size.

[Insert Table 10 about here]

Two of the control variables (*QBstart* and *QBexp*) represent the importance of the quarterback to the team's success. The quarterback's salary however is as every other player's salary on the 53-man roster subject to the salary cap restrictions. Including these control variables introduces a level of

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17 Florida: Jacksonville Jaguars, Miami Dolphins, Tampa Bay Buccaneers; Tennessee: Tennessee Titans; Texas: Dallas Cowboys, Houston Texans; Washington: Seattle Seahawks.

18 Jacksonville Jaguars (Florida); Houston Texans (Texas).

endogeneity to the model that could distort the results of the estimations. Therefore, the robustness check reported in Table 11 excludes *ceteris paribus* the quarterback variables from the model. The results remain unchanged. But, comparing the R-Squared values of the estimations reported in Table 11 to those of Table 5 provides further evidence for the importance of the quarterback and underpins the necessity of using these control variables in the primary analysis.

[Insert Table 11 about here]

6. Conclusion

The results show a significant negative relation between the success (performance) of NFL teams and the amount of the net (after-tax) salary cap represented by the personal income tax rate of the teams' home states. Teams that have a stronger regulatory salary restriction are thus less successful than teams with higher regulatory payout allowances. This relation could be explained according to the theoretical analysis in section 3 by the reduced possibility to hire players that either provide the necessary effort level or that possess the necessary talent level.

When interpreting the empirical results and drawing implications for the corporate setting several aspects need to be considered as the professional team sports industry differs from traditional business sectors in a number of ways. First, there is a difference in professional sports between athletic and economic competition (Fort et al. 1995; Szymanski 2003; Dietl et al. 2011). While from an athletic perspective opposing teams are competitors, they are complementors from an economic perspective. A single team cannot produce a marketable product. It needs at least one opponent. Fans prefer to attend matches with an uncertain outcome and enjoy close championship races. Unlike enterprises such as Google, Apple or Microsoft, which benefit from weak competitors in their respective industries, the professional sports teams need strong competitors to maximize their revenues. Therefore, NFL teams maintain self-imposed restrictions. This self-regulation is effective because the NFL focusses on a small, homogeneous geographic region and team composition within the league is very stable. Competition from outside the NFL is very weak and almost non-existing.

Because of the non-existence of serious outside competition, the NFL is in a unique position with respect to employment opportunities for star athletes. No American football league outside the NFL can compete with the league financially and with respect to public attention. Consequently, star players do not have significant outside options. Tom Brady of the New England Patriots cannot simply leave the NFL and join another league without suffering major income losses. Teams outside the NFL simply cannot offer the same level of compensation.[19] Professional athletes thus show lower salary elasticity than executives, and a decrease in salary does not necessarily lead to immediate exit to a foreign league. In contrast, an executive could easily escape compensation regulation by starting to work for a company, which is not regulated (either in a different location or in a different industry). Therefore, the negative relation between payment restrictions and performance of the regulated entity would be even stronger in settings where income elasticities are stronger and competition from outside the regulated industry sector and/or geographical region is more profound.

Despite the differences between the NFL and the corporate sector, corporations can learn from the experience of NFL teams. To mitigate the effects of external regulation, self-regulation of sectors analogous to the practice in the NFL could be an alternative to government intervention. Self-regulation by sectors, for example the banking sector, is already common practice. An extension of self-regulation to executive compensation could reduce the necessity of extensive government intervention. However, self-regulation initiatives for corporate governance by the European Union have shown that they can be successful only if mandatory compliance, monitoring and enforcement accompany the initiatives (De Jong et al. 2005). Although coordination of business sectors or whole economies is much more complicated than in professional sports leagues, regulators have undertaken various coordination efforts in the recent past. The 2009 G 20 summit,[20] which had salary caps for executive compensation on its agenda, is one example of concerted effort to avoid executive migration away from regulated economies. By including the world's major economies, the chance of executives escaping the regulation could be reduced, which would mitigate the negative effects of compensation limits on the regulated entities' performance.

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[19] According to Forbes.com (https://www.forbes.com/profile/tom-brady/ (March 27, 2017)) Tom Brady earned USD 44 million in 2016, of which USD 29 million were salaries paid by his team.

[20] See http://www.g20.utoronto.ca/2009/2009ifi.html (March 27, 2017).

Table 1 – State Personal Income Tax Rates (2016)

Table 1 reports state personal income taxes for every NFL team for 2016 comparing teams that made the playoffs (playoff teams) and teams that did not make the playoffs (non-playoff teams).

Playoff-Teams	State	Tax Rate	Non-Playoff-Teams	State	Tax Rate
Miami Dolphins	FL	0.00%	Buffalo Bills	NY	6.89%
New England Patriots	MA	5.15%	New York Jets	NJ	8.97%
Pittsburgh Steelers	PA	3.07%	Baltimore Ravens	MD	5.83%
Houston Texans	TX	0.00%	Cincinnati Bengals	OH	5.00%
Kansas City Chiefs	MO	6.08%	Cleveland Browns	OH	5.00%
Oakland Raiders	CA	14.10%	Indianapolis Colts	IN	3.30%
Dallas Cowboys	TX	0.00%	Jacksonville Jaguars	FL	0.00%
New York Giants	NJ	8.97%	Tennessee Titans	TN	0.00%
Detroit Lions	MI	4.25%	Denver Broncos	CO	4.77%
Green Bay Packers	WI	7.65%	San Diego Chargers	CA	14.10%
Atlanta Falcons	GA	6.18%	Philadelphia Eagles	PA	3.07%
Seattle Seahawks	WA	0.00%	Washington Redskins	MD	5.83%
			Chicago Bears	IL	3.75%
			Minnesota Vikings	MN	10.15%
			Carolina Panthers	NC	5.75%
			New Orleans Saints	LA	3.60%
			Tampa Bay Buccaneers	FL	0.00%
			Arizona Cardinals	AZ	4.34%
			Los Angeles Rams	CA	14.10%
			San Francisco 49ers	CA	14.10%
Average		**4.62%**	**Average**		**5.93%**

Table 2 – Definition of Variables

Variable	Description	Source
StateTax	State personal income tax rate of the home state of the respective team	NBER
TaxDiff	Difference between applicable state personal income tax and the average of all teams' state personal income tax rates in a respective season.	NBER (own calculation)
Wins	Number of wins (with a tie being counted as 0.5 win)	www.pro-football-reference.com/
LagWins	Number of wins in the previous season (with a tie being counted as 0.5 win)	www.pro-football-reference.com/
5yearWins	Number of wins in the previous five season (with a tie being counted as 0.5 win)	www.pro-football-reference.com/
Playoff	Indicator variable that takes on the value 1 if the team makes the playoffs and 0 otherwise	www.pro-football-reference.com/
LagPlayoff	Indicator variable that takes on the value 1 if the team had made the playoffs in the previous season and 0 otherwise	www.pro-football-reference.com/
5yearPlayoff	Number of playoff appearances in the previous five season	www.pro-football-reference.com/
QBstart	Number of Quarterbacks starting a game during the season	www.pro-football-reference.com/
QBexp	Years of experience of the Quarterback who starts the majority of games during the season	www.pro-football-reference.com/
CoachChange	Indicator variable that takes on the value 1 if the team changed the head coach during the year (before and during the season)	www.pro-football-reference.com/
CoachExp	Years of experience of the head coach	www.pro-football-reference.com/
Division	Indicator variable of the division of the team	www.pro-football-reference.com/

Table 3 – NFL Teams (1994-2016)

Table 3 reports descriptive statistics on every NFL team during the observation period (1994-2016). "Wins" include all wins in a regular season game with a tie being counted as 0.5 wins. "Playoffs" counts the number of overall playoff appearances per team. Average Tax Rate is the average of the state personal income tax applicable in the respective year. The teams "Carolina Panthers", "Jacksonville Jaguars", "Cleveland Browns" and "Houston Texans" were newly established, the teams "Baltimore Ravens", "Los Angeles Rams", "Tennessee Titans" relocated during the observation period.

Team	State	Average Tax Rate	Games (Total)	Wins (Total)	Average Wins (season)	Winning Percentage (Total)	Playoffs	Super Bowl	Super Bowl (Wins)	Sample Period
Arizona Cardinals	AZ	4.80	368	159.5	6.93	0.433	5	1	0	1994-2016
Atlanta Falcons	GA	6.14	368	185.5	8.07	0.504	9	2	0	1994-2016
Baltimore Ravens	MD	5.56	368	197.5	8.59	0.537	11	2	2	1994-2016
Buffalo Bills	NY	7.36	368	166	7.22	0.451	4	0	0	1994-2016
Carolina Panthers	NC	7.80	352	172.5	7.84	0.490	7	2	0	1995-2016
Chicago Bears	IL	3.41	368	171	7.43	0.465	5	1	0	1994-2016
Cincinnati Bengals	OH	6.62	368	163.5	7.11	0.444	7	0	0	1994-2016
Cleveland Browns	OH	6.45	288	88	4.89	0.306	1	0	0	1999-2016
Dallas Cowboys	TX	0.00	368	199	8.65	0.541	11	1	1	1994-2016
Denver Broncos	CO	4.83	368	224	9.74	0.609	13	4	3	1994-2016
Detroit Lions	MI	4.24	368	142	6.17	0.386	7	0	0	1994-2016
Green Bay Packers	WI	7.11	368	236.5	10.28	0.643	18	3	2	1994-2016
Houston Texans	TX	0.00	240	106	7.07	0.442	4	0	0	2002-2016
Indianapolis Colts	IN	3.39	368	221	9.61	0.601	16	2	1	1994-2016
Jacksonville Jaguars	FL	0.00	352	155	7.05	0.440	6	0	0	1995-2016
Kansas City Chiefs	MO	6.04	368	192	8.35	0.522	9	0	0	1994-2016
Los Angeles Rams	CA	6.38	368	159.5	6.93	0.433	5	2	1	1994-2016
Miami Dolphins	FL	0.00	368	186	8.09	0.505	9	0	0	1994-2016
Minnesota Vikings	MN	8.58	368	195.5	8.50	0.531	11	0	0	1994-2016
New England Patriots	MA	5.48	368	255	11.09	0.693	18	8	5	1994-2016
New Orleans Saints	LA	3.71	368	178	7.74	0.484	6	1	1	1994-2016
New York Giants	NJ	7.94	368	191.5	8.33	0.520	9	3	2	1994-2016
New York Jets	NJ	7.94	368	171	7.43	0.465	7	0	0	1994-2016
Oakland Raiders	CA	11.28	368	152	6.61	0.413	4	1	0	1994-2016
Philadelphia Eagles	PA	2.95	368	201	8.74	0.546	12	1	0	1994-2016
Pittsburgh Steelers	PA	2.95	368	232.5	10.11	0.632	14	5	2	1994-2016
San Diego Chargers	CA	11.28	368	181	7.87	0.492	8	0	0	1994-2016
San Francisco 49ers	CA	11.28	368	181.5	7.89	0.493	10	2	1	1994-2016
Seattle Seahawks	WA	0.00	368	198.5	8.63	0.539	12	3	1	1994-2016
Tampa Bay Buccaneers	FL	0.00	368	169	7.35	0.459	7	1	1	1994-2016
Tennessee Titans	TN	0.00	368	179	7.78	0.486	6	1	0	1994-2016
Washington Redskins	MD	5.39	368	158	6.87	0.429	5	0	0	1994-2016
Average		4.97	360.5	180.25	7.97	0.498	8.63	1.44	0.72	1994-2016
Median		5.44	368.0	180.0	7.86	0.491	7.50	1.00	0.00	1994-2016
Min		0.00	240.0	88.0	4.89	0.306	1.00	0.00	0.00	1994-2016
Max		11.28	368.0	255.0	11.09	0.693	18.00	8.00	5.00	1994-2016

Table 4 – Descriptive Statistics

Table 4 reports descriptive statistics for 1994-2016; for a description of the variables, see Table 2.

Variable	Mean	Std. dev.	Min	25th perc.	Median	75th perc.	Max	Obs
Wins	8	3.040	0	6	8	10	16	721
Playoff	0.382	0.486	0	0	0	1	1	721
StateTax	5.014	3.465	0	3.00	5.150	6.89	14.1	721
TaxDiff	0.000	3.459	-5.337	-2.038	0.146	2.026	8.913	721
QBstart	1.688	0.775	1	1	2	2	4	721
QBexp	5.535	4.055	0	2	5	8	20	721
CoachExp	5.463	5.225	0	1	4	8	32	721
CoachChange	0.227	0.419	0	0	0	0	1	721

Table 5 – Fixed effects regression results (wins)

Table 5 reports results of the fixed effects panel regression over the period 1994-2016. The dependent variable is wins. The variables are defined in Table 2. Robust standard errors are in parentheses; year fixed-effects are included. Coefficients significant at the 10%, 5% and 1% levels are marked with *, ** and ***, respectively.

	exp. sign	(1)	(2)	(3)	(4)	(5)	(6)
StateTax	-	-0.2060*	-0.2042**	-0.2533**			
		(0.1022)	(0.0974)	(0.1190)			
TaxDiff	-				-0.1975*	-0.1877*	-0.2372*
					(0.1145)	(0.1079)	(0.1279)
LagWins	+		0.1289***			0.1290***	
			(0.0351)			(0.0353)	
5yearWins	+			-0.0169			-0.0162
				(0.0899)			(0.0906)
QBstart	-	-1.2971***	-1.3591***	-1.5494***	-1.2936***	-1.3539***	-1.5429***
		(0.1807)	(0.1873)	(0.1912)	(0.1799)	(0.1863)	(0.1901)
QBexp	+	0.0706**	0.0537*	0.0543	0.0700**	0.0532*	0.0536
		(0.0303)	(0.0307)	(0.0360)	(0.0305)	(0.0309)	(0.0365)
CoachExp	+	0.0055	-0.0020	0.0010	0.0053	-0.0021	0.0008
		(0.0247)	(0.0252)	(0.0294)	(0.0248)	(0.0255)	(0.0299)
CoachChange	-	-0.8711***	-0.5589**	-0.8277***	-0.8749***	-0.5629**	-0.8341***
		(0.2446)	(0.2449)	(0.2878)	(0.2457)	(0.2455)	(0.2896)
Division	?	-0.0047	-0.0022	-0.0075	-0.0021	0.0016	-0.0028
		(0.0305)	(0.0295)	(0.0463)	(0.0301)	(0.0287)	(0.0456)
Constant		11.0348***	10.1512***	11.9718***	9.9802***	9.0957***	10.6585***
		(0.7674)	(0.7982)	(0.9956)	(0.4273)	(0.5323)	(0.8897)
N		721	689	561	721	689	561
r2		0.1407	0.1601	0.1778	0.1403	0.1594	0.1768

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6 – Probit Regression (Playoff)

Table 6 reports results of the probit regression over the period 1994-2016. The dependent variable is playoff. The variables are defined in Table 2. Robust standard errors are in parentheses. Coefficients significant at the 10%, 5% and 1% levels are marked with *, ** and ***, respectively.

	exp. sign	(1)	(2)	(3)	(4)	(5)	(6)
StateTax	-	-0.0216	-0.0230*	-0.0304*			
		(0.0168)	(0.0141)	(0.0166)			
TaxDiff	-				-0.0214	-0.0226*	-0.0300*
					(0.0168)	(0.0142)	(0.0165)
LagPlayoff	+		0.4751***			0.4752***	
			(0.1005)			(0.1006)	
5yearPlayoff	+			0.1389***			0.1391***
				(0.0438)			(0.0439)
QBstart	-	-0.4167***	-0.4122***	-0.4578***	-0.4163***	-0.4115***	-0.4570***
		(0.1000)	(0.1017)	(0.1103)	(0.0999)	(0.1016)	(0.1101)
QBexp	+	0.0288**	0.0198	0.0107	0.0287**	0.0197	0.0106
		(0.0143)	(0.0137)	(0.0167)	(0.0143)	(0.0138)	(0.0168)
CoachExp	+	0.0140	0.0140	0.0185	0.0140	0.0140	0.0185
		(0.0132)	(0.0113)	(0.0123)	(0.0132)	(0.0113)	(0.0123)
CoachChange	-	-0.4186***	-0.2366*	-0.3049*	-0.4188***	-0.2370*	-0.3054*
		(0.1384)	(0.1349)	(0.1645)	(0.1383)	(0.1349)	(0.1643)
Division	?	0.0122	0.0094	0.0078	0.0125	0.0098	0.0084
		(0.0137)	(0.0121)	(0.0202)	(0.0136)	(0.0121)	(0.0201)
Team	?	0.0009	0.0028	0.0064	0.0008	0.0026	0.0062
		(0.0084)	(0.0071)	(0.0085)	(0.0083)	(0.0071)	(0.0085)
Constant		0.2339	0.0452	0.0589	0.1243	-0.0717	-0.0960
		(0.3008)	(0.2776)	(0.3101)	(0.2680)	(0.2470)	(0.2730)
N		721	689	561	721	689	561
ll		-445.9222	-416.9122	-337.5059	-445.9533	-416.9598	-337.5575

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7 – Random effects regression (wins)

Table 7 reports results of the random effects panel regression over the period 1994-2016. The dependent variable is wins. The variables are defined in Table 2. Robust standard errors are in parentheses; year fixed-effects are included. Coefficients significant at the 10%, 5% and 1% levels are marked with *, ** and ***, respectively.

	exp. sign	(1)	(2)	(3)	(4)	(5)	(6)
StateTax	-	-0.0612*	-0.0607*	-0.0741**			
		(0.0364)	(0.0312)	(0.0366)			
TaxDiff	-				-0.0600	-0.0595*	-0.0728**
					(0.0371)	(0.0313)	(0.0366)
LagWins	+		0.2285***			0.2286***	
			(0.0344)			(0.0344)	
5yearWins	+			0.2981***			0.2987***
				(0.0819)			(0.0819)
QBstart	-	-1.2947***	-1.2892***	-1.4477***	-1.2937***	-1.2881***	-1.4463***
		(0.1651)	(0.1608)	(0.1676)	(0.1651)	(0.1608)	(0.1674)
QBexp	+	0.0993***	0.0716***	0.0550	0.0991***	0.0714**	0.0547
		(0.0299)	(0.0277)	(0.0339)	(0.0300)	(0.0278)	(0.0341)
CoachExp	+	0.0277	0.0223	0.0306	0.0277	0.0223	0.0306
		(0.0276)	(0.0262)	(0.0294)	(0.0276)	(0.0262)	(0.0294)
CoachChange	-	-1.0261***	-0.4780*	-0.8395***	-1.0276***	-0.4796*	-0.8413***
		(0.2492)	(0.2563)	(0.2866)	(0.2496)	(0.2563)	(0.2867)
Division	?	0.0098	0.0143	0.0161	0.0104	0.0151	0.0170
		(0.0298)	(0.0271)	(0.0377)	(0.0297)	(0.0269)	(0.0376)
Constant		9.9467***	8.1483***	8.0626***	9.6348***	7.8375***	7.6792***
		(0.5740)	(0.5671)	(0.9186)	(0.4810)	(0.5199)	(0.8399)
N		721	689	561	721	689	561
r2		0.1772	0.2216	0.2496	0.1771	0.2214	0.2493

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8 – Robustness Checks (StateTax)

Table 8 reports results of the fixed effects panel regression over the period 1994-2016 for four different sub-samples: specifications (1)-(3) exclude teams that did not play throughout the whole observation period (expansion teams); specifications (4)-(6) exclude observations from the most successful team throughout the whole observation period (New England Patriots); specifications (7)-(9) exclude observations from the least successful team throughout the whole observation period (Cleveland Browns); and specifications (10)-(12) exclude observations from both the most and the least successful team. The dependent variable is wins. The variables are defined in Table 2. Robust standard errors are in parentheses; year fixed-effects are included. Coefficients significant at the 10%, 5% and 1% levels are marked with *, ** and ***, respectively.

	exp.	without expansion teams			without best team (New England)			without worst team (Cleveland)			without best and worst team		
	sign	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
StateTax	-	-0.2351**	-0.2378**	-0.2544*	-0.1725	-0.1708*	-0.2250*	-0.2176**	-0.2229**	-0.2669**	-0.1815	-0.1879*	-0.2383*
		(0.1100)	(0.1030)	(0.1293)	(0.1029)	(0.0976)	(0.1225)	(0.1063)	(0.0997)	(0.1212)	(0.1070)	(0.0999)	(0.1245)
LagWins	+		0.1388***			0.1307***			0.1296***			0.1313***	
			(0.0387)			(0.0360)			(0.0354)			(0.0364)	
5yearWins	+			0.0079			-0.0314			-0.0179			-0.0323
				(0.0934)			(0.0925)			(0.0905)			(0.0932)
QBstart	-	-1.24***	-1.31***	-1.53***	-1.32***	-1.39***	-1.59***	-0.01	-0.01	-0.01	0.01	0.01	0.01
		(0.1959)	(0.2028)	(0.2078)	(0.1826)	(0.1892)	(0.1903)	(0.0313)	(0.0301)	(0.0464)	(0.0299)	(0.0287)	(0.0458)
QBexp	+	0.0736**	0.0560	0.0477	0.0647**	0.0479	0.0515	-1.2891***	-1.3465***	-1.5516***	-1.3168***	-1.3762***	-1.5984***
		(0.0339)	(0.0341)	(0.0415)	(0.0309)	(0.0312)	(0.0374)	(0.1856)	(0.1919)	(0.1956)	(0.1874)	(0.1938)	(0.1946)
CoachExp	+	-0.0071	-0.0164	-0.0134	-0.0021	-0.0102	-0.0077	0.0711**	0.0552*	0.0552	0.0650**	0.0492	0.0524
		(0.0281)	(0.0284)	(0.0333)	(0.0252)	(0.0257)	(0.0304)	(0.0310)	(0.0313)	(0.0370)	(0.0316)	(0.0318)	(0.0384)
Coach-	-	-0.9730***	-0.6668**	-1.0108***	-0.8506***	-0.5251**	-0.7973**	0.0056	-0.0021	0.0007	-0.0019	-0.0102	-0.0080
Change		(0.2667)	(0.2608)	(0.3075)	(0.2472)	(0.2480)	(0.2908)	(0.0248)	(0.0252)	(0.0294)	(0.0253)	(0.0257)	(0.0304)
Division	?	-0.0096	-0.0100	-0.0173	0.0084	0.0105	0.0087	-0.8575***	-0.5536**	-0.8205**	-0.8350***	-0.5184*	-0.7882**
		(0.0343)	(0.0327)	(0.0506)	(0.0292)	(0.0281)	(0.0456)	(0.2542)	(0.2551)	(0.2987)	(0.2569)	(0.2586)	(0.3017)
Constant		11.27***	10.34***	12.03***	10.80***	9.92***	11.89***	11.10***	10.24***	12.08***	10.85***	10.01***	12.00***
		(0.7931)	(0.8309)	(1.0411)	(0.7853)	(0.7966)	(1.0169)	(0.7880)	(0.8182)	(1.0090)	(0.8059)	(0.8151)	(1.0301)
N		634	606	494	698	667	543	703	672	548	680	650	530
r2		0.1395	0.1649	0.1838	0.1417	0.1624	0.1846	0.1395	0.1592	0.1784	0.1406	0.1614	0.1853

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9 – Robustness Checks (TaxDiff)

Table 9 reports results of the fixed effects panel regression over the period 1994-2016 for four different sub-samples: specifications (1)-(3) exclude teams that did not play throughout the whole observation period (expansion teams); specifications (4)-(6) exclude observations from the most successful team throughout the whole observation period (New England Patriots); specifications (7)-(9) exclude observations from the least successful team throughout the whole observation period (Cleveland Browns); and specifications (10)-(12) exclude observations from both the most and the least successful team. The dependent variable is wins. The variables are defined in Table 2. Robust standard errors are in parentheses; year fixed-effects are included. Coefficients significant at the 10%, 5% and 1% levels are marked with *, ** and ***, respectively.

	exp.	without expansion teams			without best team (New England)			without worst team (Cleveland)			without best and worst team		
	sign	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
TaxDiff	-	-0.2426*	-0.2328**	-0.2442*	-0.1635	-0.1539	-0.2051	-0.2179*	-0.2155*	-0.2579*	-0.1807	-0.1797	-0.2252
		(0.1221)	(0.1119)	(0.1383)	(0.1171)	(0.1100)	(0.1337)	(0.1196)	(0.1099)	(0.1306)	(0.1227)	(0.1124)	(0.1363)
LagWins	+		0.1385***			0.1307***			0.1295***			0.1312***	
			(0.0389)			(0.0361)			(0.0357)			(0.0365)	
5yearWins	+			0.0072			-0.0305			-0.0175			-0.0314
				(0.0943)			(0.0932)			(0.0913)			(0.0939)
QBstart	-	-1.2383***	-1.3020***	-1.5250***	-1.3192***	-1.3821***	-1.5884***	-0.0003	0.0011	-0.0035	0.0130	0.0136	0.0124
		(0.1946)	(0.2015)	(0.2065)	(0.1817)	(0.1881)	(0.1891)	(0.0309)	(0.0293)	(0.0457)	(0.0295)	(0.0279)	(0.0451)
QBexp	+	0.0729**	0.0553	0.0469	0.0643**	0.0476	0.0512	-1.2850***	-1.3407***	-1.5445***	-1.3128***	-1.3707***	-1.5914***
		(0.0340)	(0.0343)	(0.0420)	(0.0311)	(0.0314)	(0.0378)	(0.1846)	(0.1908)	(0.1945)	(0.1864)	(0.1926)	(0.1934)
CoachExp	+	-0.0072	-0.0164	-0.0134	-0.0021	-0.0102	-0.0077	0.0704**	0.0545*	0.0544	0.0645*	0.0488	0.0519
		(0.0281)	(0.0287)	(0.0339)	(0.0254)	(0.0261)	(0.0311)	(0.0311)	(0.0315)	(0.0374)	(0.0317)	(0.0320)	(0.0388)
Coach-	-	-0.9740***	-0.6702**	-1.0161***	-0.8536***	-0.5280**	-0.8022**	0.0055	-0.0022	0.0006	-0.0019	-0.0101	-0.0079
Change		(0.2701)	(0.2624)	(0.3098)	(0.2480)	(0.2483)	(0.2924)	(0.0248)	(0.0254)	(0.0298)	(0.0254)	(0.0260)	(0.0310)
Division	?	-0.0070	-0.0058	-0.0129	0.0106	0.0139	0.0132	-0.8600***	-0.5568**	-0.8254**	-0.8366***	-0.5208*	-0.7918**
		(0.0337)	(0.0317)	(0.0499)	(0.0288)	(0.0273)	(0.0450)	(0.2558)	(0.2560)	(0.3009)	(0.2582)	(0.2593)	(0.3039)
Constant		10.0596***	9.1196***	10.7194***	9.9184***	9.0398***	10.7148***	9.9832***	9.0918***	10.7025***	9.9207***	9.0357***	10.7570***
		(0.4615)	(0.5886)	(0.9524)	(0.4391)	(0.5364)	(0.9012)	(0.4322)	(0.5395)	(0.9001)	(0.4443)	(0.5439)	(0.9119)
N		634	606	494	698	667	543	703	672	548	680	650	530
r2		0.1394	0.1645	0.1830	0.1413	0.1618	0.1836	0.1393	0.1587	0.1776	0.1404	0.1610	0.1844

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10 – Robustness Check – Without teams in states with no personal income tax

Table 10 reports results of the fixed effects panel regression over the period 1994-2016 for a sub-sample excluding teams that are located in states that do not apply a personal income tax (Florida, Tennessee, Texas, Washington = total of seven teams and 152 team-year observations). The dependent variable is wins. The variables are defined in Table 2. Robust standard errors are in parentheses; year fixed-effects are included. Coefficients significant at the 10%, 5% and 1% levels are marked with *, ** and ***, respectively.

	exp. sign	(1)	(2)	(3)	(4)	(5)	(6)
StateTax	-	-0.2362**	-0.2385**	-0.2888**			
		(0.1004)	(0.0955)	(0.1204)			
TaxDiff	-				-0.2540**	-0.2447**	-0.3119**
					(0.1060)	(0.1012)	(0.1249)
LagWins	+		0.1260***			0.1254***	
			(0.0397)			(0.0399)	
5yearWins	+			-0.0742			-0.0772
				(0.1046)			(0.1054)
QBstart	-	-1.3915***	-1.4557***	-1.5905***	-1.3886***	-1.4515***	-1.5858***
		(0.1669)	(0.1753)	(0.1920)	(0.1656)	(0.1739)	(0.1900)
QBexp	+	0.0627*	0.0473	0.0541	0.0610*	0.0459	0.0520
		(0.0354)	(0.0362)	(0.0390)	(0.0355)	(0.0364)	(0.0391)
CoachExp	+	0.0088	0.0030	-0.0006	0.0085	0.0025	-0.0015
		(0.0303)	(0.0304)	(0.0326)	(0.0302)	(0.0305)	(0.0325)
CoachChange	-	-0.6763**	-0.3775	-0.6958**	-0.6782**	-0.3832	-0.7020**
		(0.2443)	(0.2775)	(0.3232)	(0.2440)	(0.2777)	(0.3233)
Division	?	-0.0319	-0.0299	-0.0467	-0.0297	-0.0261	-0.0431
		(0.0337)	(0.0324)	(0.0515)	(0.0331)	(0.0315)	(0.0507)
Constant		11.8565***	10.9863***	13.2874***	10.6843***	9.7817***	11.8778***
		(0.8902)	(0.8925)	(1.1930)	(0.4891)	(0.5618)	(0.9968)
N		569	544	444	569	544	444
r2		0.1494	0.1703	0.1814	0.1497	0.1701	0.1820

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11 – Robustness Check – Without Quarterbacks

Table 11 reports results of the fixed effects panel regression over the period 1994-2016. The variables controlling for the position of Quarterback are excluded. The dependent variable is wins. The variables are defined in Table 2. Robust standard errors are in parentheses; year fixed-effects are included. Coefficients significant at the 10%, 5% and 1% levels are marked with *, ** and ***, respectively.

	exp. sign	(1)	(2)	(3)	(4)	(5)	(6)
StateTax	-	-0.1829*	-0.1647*	-0.2324*			
		(0.1049)	(0.0943)	(0.1166)			
TaxDiff	-				-0.1968*	-0.1771*	-0.2500*
					(0.1223)	(0.1106)	(0.1308)
LagWins	+		0.1397***			0.1394***	
			(0.0363)			(0.0365)	
5yearWins	+			0.0161			0.0157
				(0.0723)			(0.0729)
CoachExp	+	0.0174	0.0061	0.0065	0.0171	0.0060	0.0064
		(0.0290)	(0.0283)	(0.0370)	(0.0288)	(0.0283)	(0.0369)
CoachChange	-	-0.9558***	-0.6005**	-0.9157***	-0.9586***	-0.6042**	-0.9196***
		(0.2530)	(0.2579)	(0.3155)	(0.2539)	(0.2578)	(0.3159)
Division	?	-0.0123	-0.0085	-0.0176	-0.0105	-0.0058	-0.0142
		(0.0364)	(0.0353)	(0.0532)	(0.0361)	(0.0347)	(0.0527)
Constant		9.1321***	7.8909***	9.3597***	8.2014***	7.0511***	8.1740***
		(0.6936)	(0.7449)	(0.9890)	(0.3338)	(0.4853)	(0.8043)
N		721	689	561	721	689	561
r2		0.0261	0.0390	0.0248	0.0263	0.0392	0.0252

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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